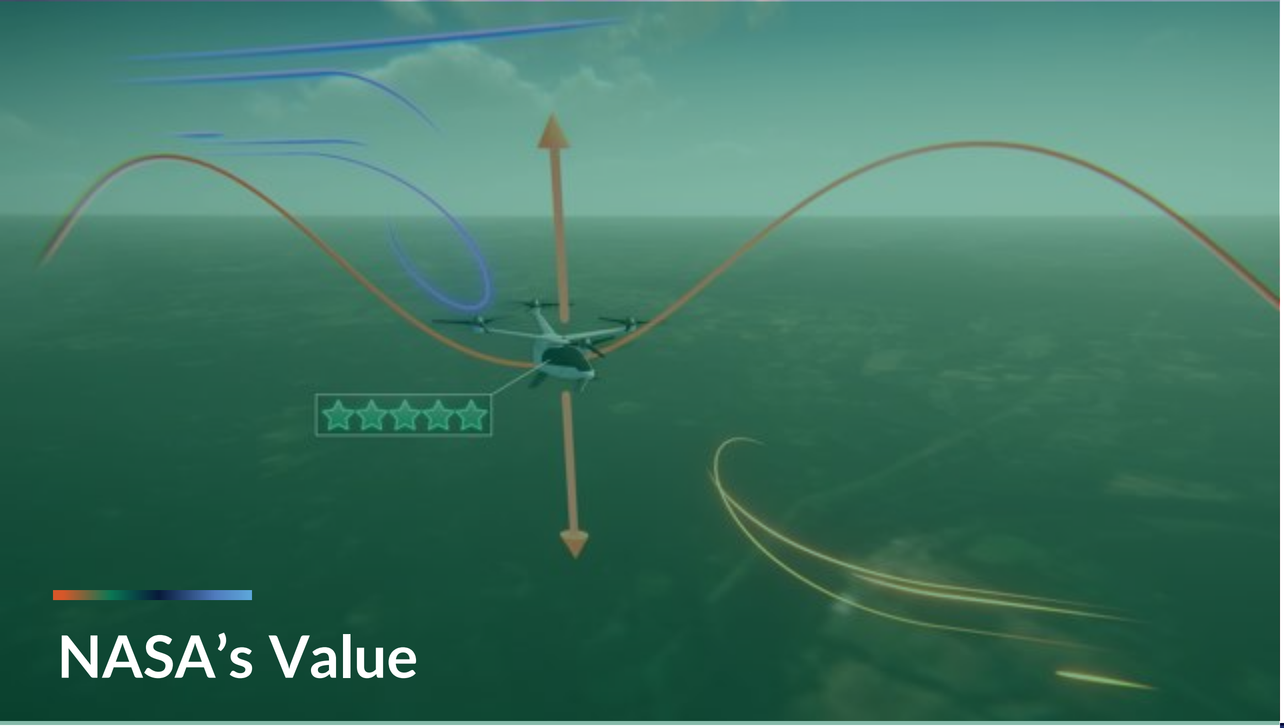
Gaining Momentum: The Importance of a Second Wind in the Air Mobility Industry

Starr Ginn – NASA AAM Project Office Lead Strategist



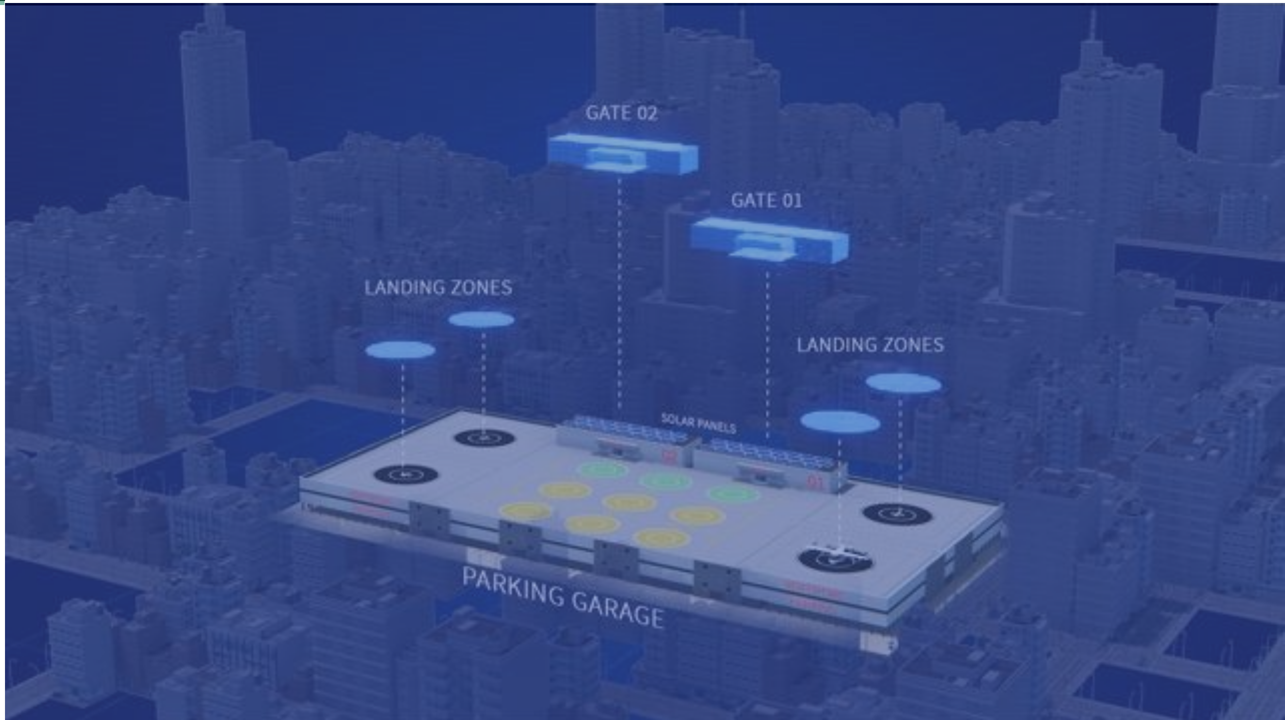
NASA’s Value

NASA is conducting research, development, and testing to ensure the U.S. has global leadership in the Advanced Air Mobility market = U.S. economic benefit

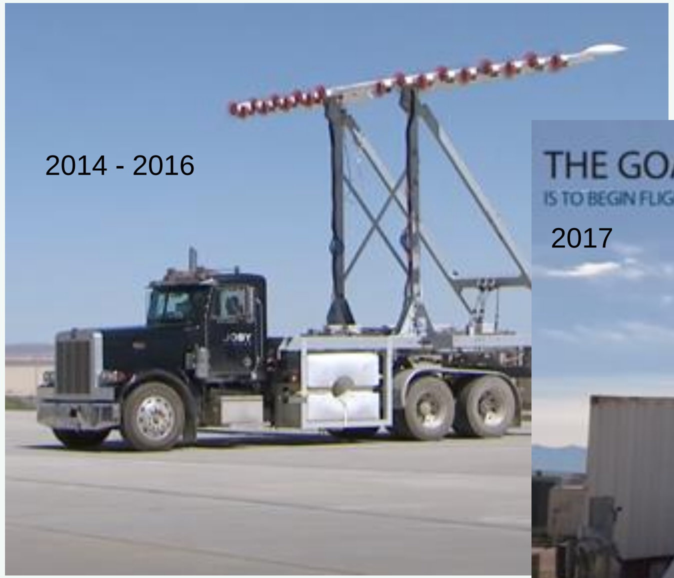
- **Accelerate technology:** NASA is researching the total ecosystem through modeling, simulations, and flights to see how the pieces will work together in harmony (airspace, vertiports, aircraft, automation).

- **Accelerate policy and guidance:** NASA is informing standards to enable regulators like the FAA to establish rules and policy.

- **Accelerate aviation leadership:** NASA will help springboard the AAM industry to enable successful domestic industry business models.



It’s Harder Than It Looks


2014 - 2016

2017


2019

Sampling of Ongoing External Requests to the X-57 project

As-built information on distributed electrical system weight, thermal, EMI, efficiency, and performance

USAF Agility Prime

X-57 data supporting electric / hybrid aircraft study to identify performance gaps for future S&T research

OUSD Research & Engineeri1ng

Reference data for means of compliance for demonstration of minimum flight speed with high-lift propellers

ASTM Committee F44

Standard F3179 & F3180

X-57 data supporting development of test facilities

FAA Tech Center

Reference data for means of compliance for demonstration of minimum control speed with distributed propulsion system

ASTM Committee F44

Standard F3173

X-57 motor and battery components as FAA moves towards performance-based rules in Part 33

FAA Policy & Innovation

VFS eVTOL Flight Test Council

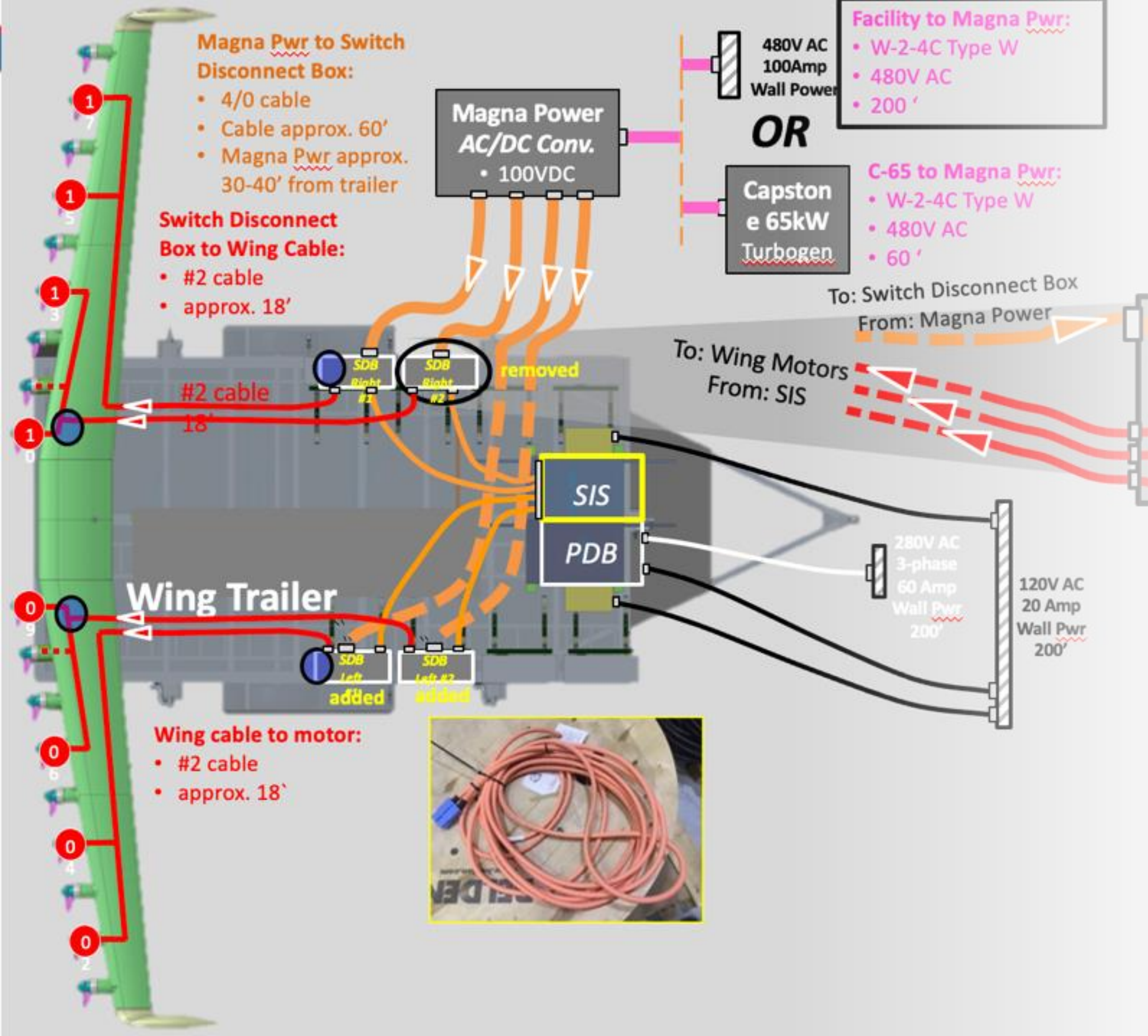
Simulation work in support of X-57 Mod IV flights, including piloted simulation exercises

ASTM Committee F44

Working Group WK66028

X-57 personnel developing a Distributed Electric Propulsion standard at request of subcommittee

X-57 is providing essential information to a broad collection of government and industry groups



Continued Research

Mission-Aware

Distributed Electric Propulsion

optimal reconfiguration for efficiency/range/fault tolerance.

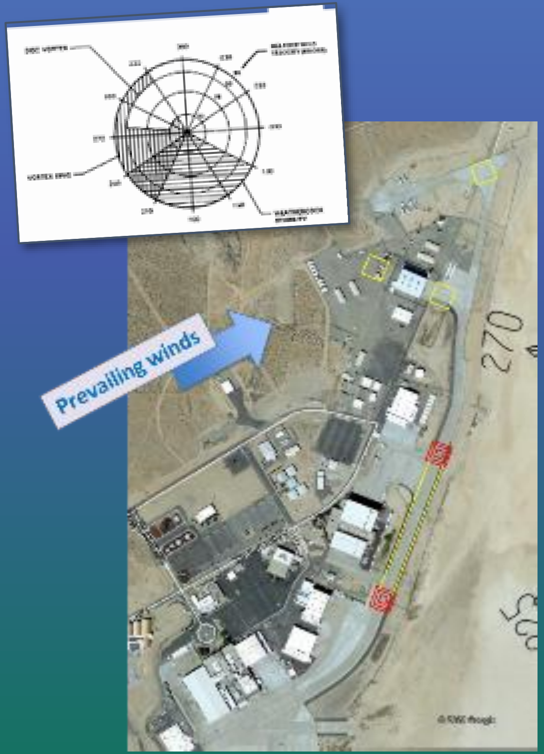
Making decisions about how to allocate control now while taking into account future mission profile and uncertainties.

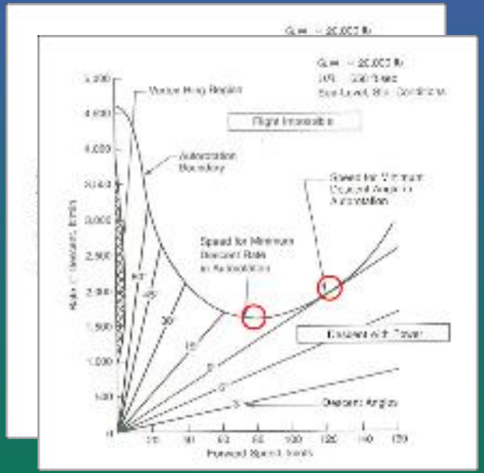
Vehicle Characteristics required for Urban Operations

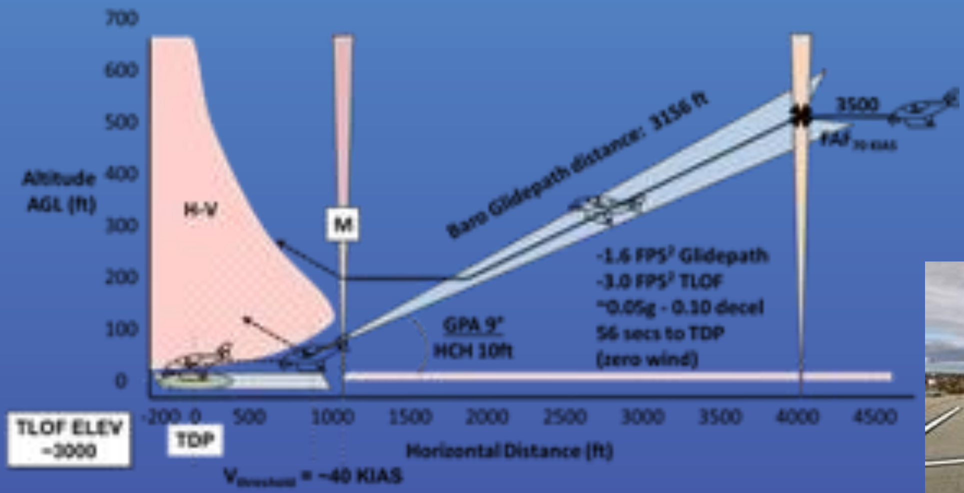
- UAM Performance requirements
- Minimum Stability requirements (IFR)
- All Azimuth Capability (controllability)
- Wind/structure dynamic interface (proximity of landing zone to structures)
- Appropriate Handling Qualities

Viable UAM Approaches/Airspace

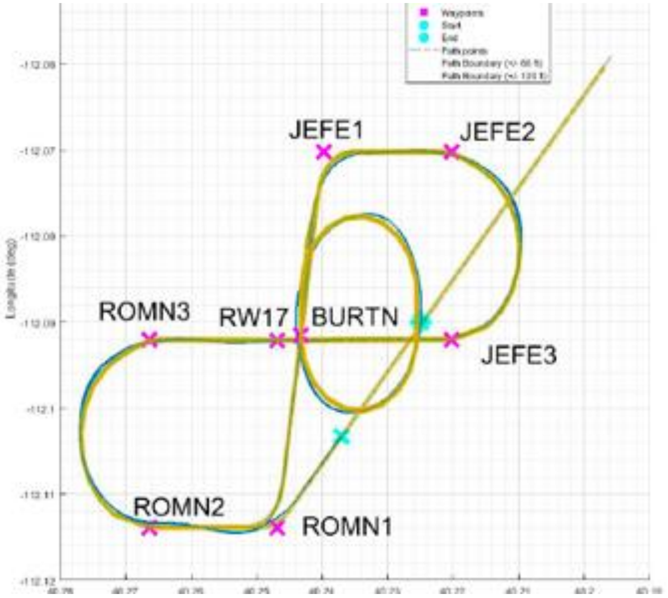
- Viable UAM IMC approaches
- Heliport and Vertiport ops







ATI LVC & Data Collection



UAM IFR Condensed Operations

- FAA Experimental AIRINC 424 format Procedures ingested in an FMS autopilot using a variable stability, Ryan Navion. 6-9 degree approaches, 0.1g ride quality, RNP 0.05-0.01, 2nm radius to airport and entrance into Final Approach Fix
- Radius to airport at 2500ft suggests a group of vertiports could be placed as close as 4 miles from the next group

Use Portable Infrastructure to Gain Community Confidence Before Large Investments are Made

Portable Infrastructure to Gain Community Confidence

Provide a mobile, safe and stable launch and recovery surface for UAM aircraft

- Accommodate up to 7° slope at deployment site.
- A minimum high precision field elevation transceiver reporting in 0.1 ft in accordance with Datum WGS-84 ITRF (2014).
- GNSS receiver, GNSS antenna, data radio transmitter, data radio antenna. The data radio should utilize the uncontrolled frequency band. Suggested frequencies are 433 MGHz and 5.8 GHz.

Provide terminal weather information

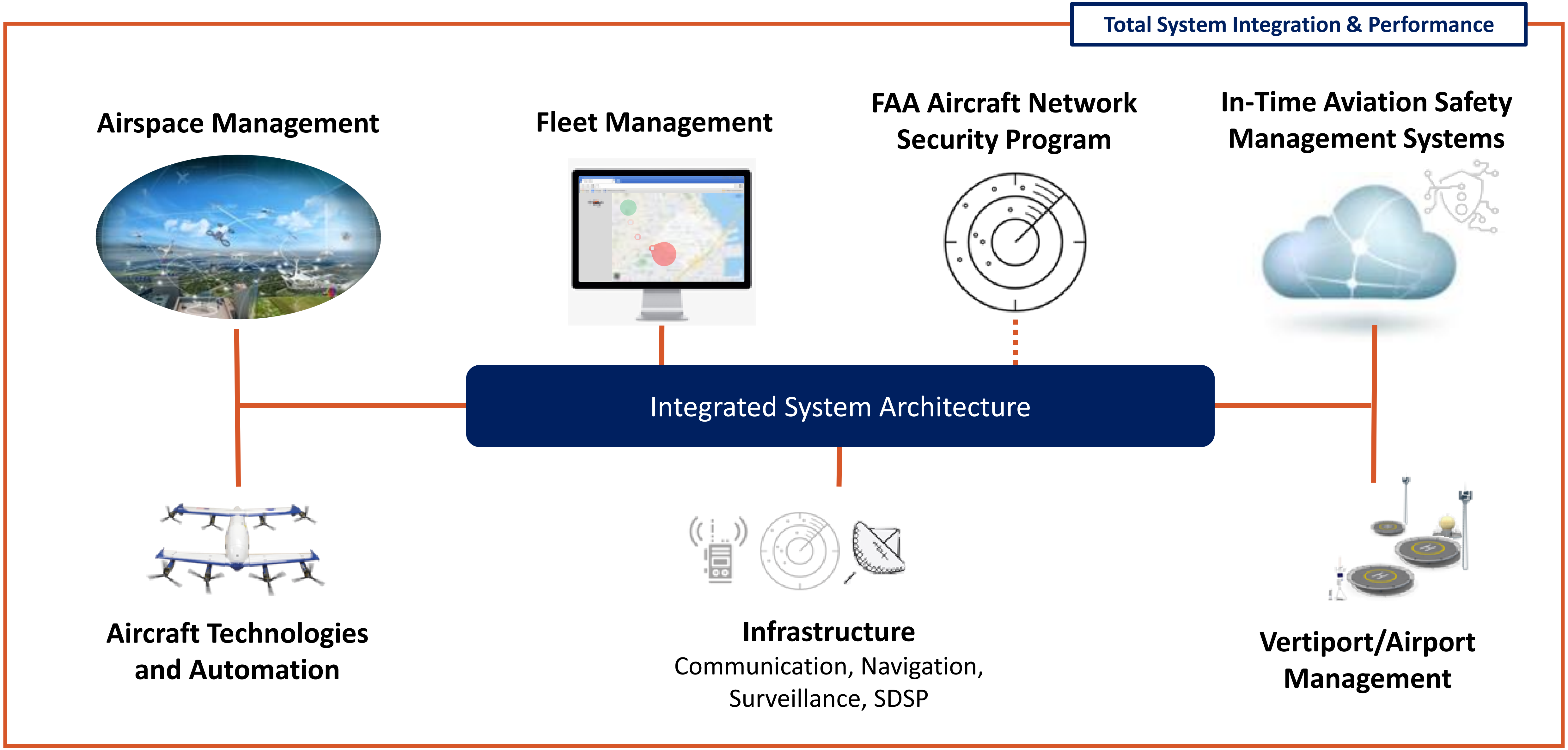
- 2 min intervals, 10 degree all azimuths.
- temperature range of -20 degrees C to +85 degrees C

A minimum 4 lights that illuminate the landing surface for night operation testing

A renewable energy source (i.e. solar, chemical, steam) to power the systems

Provide Real Time Kinematics for PBN operations

There is a process for 3rd party procedures, however, the 3rd party process only applies to RNAV(RNP) and RNAV(GPS) LNAV and LNAV/VNAV minima.



NASA's role emphasizes an integrated system level approach to deliver requirements for total system performance

NASA AAM System Design Process

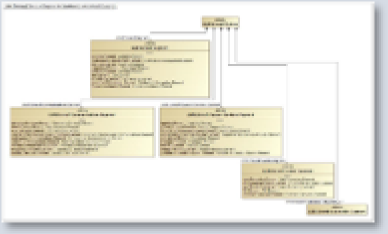
Stakeholder Expectations

Identify the key stakeholders, assumptions, constraints, and document the concept of operations and use within the intended environment.

Requirements Definition

Iteratively derive the operational requirements from the CONOPs and then decomposes those into functional and performance requirements.

Logical Decomposition



Creates the functional requirements and logical architectures that identifies "what" the system must be able to achieve to meet the stakeholder expectations.

Design Solution Definition

Translates the functional requirements and logical architectures into candidate design solutions that are analyzed through design trade studies and tests to select the preferred solution.

Validate

MBSE

M&S

NC

Validate

Validate

NASA Tech Transfer

Regulation, Policy, and Standardization

NASA's Advanced Air Mobility (AAM) Ecosystem Partnership and Collaboration Approach

NASA Research and NC Partnerships

Academia

Airspace Partners

Other Gov't Agencies

State/Local Community Partners

Infrastructure Partners

Vehicle Partners

Standards Development Organizations

AAM Ecosystem Working Groups (AEWG)

Learn more here:

NASA's AAM Ecosystem Partnership and Collaboration Approach

NASA and FAA AAM Working Groups

UAM Aircraft Design and Development	Concepts & Transversal Activities (Conops, Community, NC)
Vehicle Automation Concepts and Technologies	Airspace Design and Operations

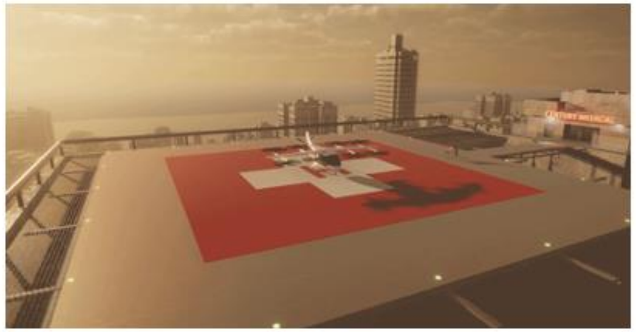
International Forum for Aviation Research (IFAR)

Eco-system wide partnership base designed to accelerate technology development and operationalization

NASA's AAM Playbook Series

https://www.nasa.gov/feature/nasa-is-creating-an-advanced-air-mobility-playbook

EMERGENCY RESPONSE



HEALTHCARE

AUTOMATION

VERTIPORTS

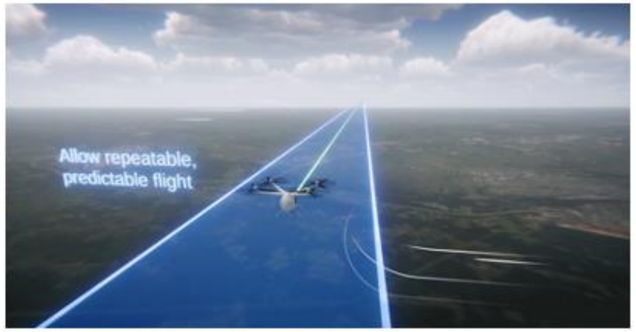
TRAVEL TIME

NOISE

INFRASTRUCTURE

FUTURE AIRSPACE

SAFETY



RIDE QUALITY

CARGO DELIVERY

ACCESSIBILITY

NASA